MULTILAYER PRODUCT MADE OUT OF A SUBSTRATE AND ON EITHER SIDE AT LEAST ONE COVER LAYER; PROCESS FOR THE MANUFACTURE OF A MULTILAYER PRODUCT AND PAINTED MULTILAYER PRODUCT AND PROCESS FOR PAINTING A MULTILAYER PRODUCT

BACKGROUND OF THE INVENTION

Glass fibre reinforce products are generally known. They are used for many purposes. One class of glass fibre reinforced products consists of sheet like products with randomly distributed fibres embedded in a thermoplastic resin. Depending on their process of manufacture they can be rather densely packed resulting in sheet with a density of more than 1.00 gram per cm^3, usually more than 1.20 grams per cm^3 or in loosely packed sheet structures with a density of less than 1.20, usually less than 1.00 grams per cm^3.

The present invention deals with products having a substrate made out of the loosely packed sheet structures.

Said loosely packed sheet structures have outstanding strength to weight ratio making them suitable for many applications.

In some applications it is however desirable to improve the stiffness and the surface quality of the known loosely packed structures further.

It is known to improve the surface quality of fibre-reinforced sheet by covering the sheet with a layer or film of a thermoplastic not containing any fibres. Upon further processing of the thus covered sheet, in particular when heating it the fibres of the sheet tend to protrude through the surface of the cover layer thus diminishing the surface quality again.

To increase the mechanical properties of thermoplastic materials reinforced with glass fibres it has been proposed to cover the thermoplastic sheet with layers of materials containing aligned high performance fibres.

SUMMARY OF THE INVENTION

The multilayer product of the invention comprises a substrate in the form of a glass fibre reinforced thermoplastic product with randomly distributed fibres and with a density of less than 1.20 grams per cm^3, preferably less than 1.00 grams per cm^3 and a cover layer being a long or continuous fibre reinforced thermoplastic plastic film with the long or continuous fibres being orientated approximately parallel to one another.

The product of the invention has an optimum combination of good mechanical properties and surface quality. Of importance is further that its coefficient of thermal expansion (CTE) is very low. For products of the invention where the substrate is covered at each side with several cover layers wherein the orientation of the long or continuous fibres in each adjacent cover layer is different it is possible to obtain a product that for practical purposes can be considered as isotropic.

The thermoplastic material in the substrate and in the cover layer can be the same or can be different. The thermoplastic can be chosen among all known thermoplastic materials.

The product of the invention can be shaped by heating the multilayer product and pressing it or vacuum consolidating it in a mould having the desired shape.

It can be painted with or without an intermediate surface treatment such as applying a primer, flame treatment and the like.

DETAILED DESCRIPTION OF THE INVENTION

The multilayer product of the invention comprises a substrate that is provided at each side with at least one cover layer.

The substrate is formed by a glass fibre reinforced thermoplastic product with randomly distributed fibres and with a density of less than 1.20, preferably less than 1.00 gram per cm^3.

The cover layer is formed by a long or continuous fibre reinforced thermoplastic film, the fibres being oriented approximately parallel to one another within each layer.

THE SUBSTRATE

Substrates of the kind described above are well-known and commercially available products. They can be manufactured in various ways. They can be made by a process similar to paper making wherein the reinforcing fibres and the thermoplastic material are mixed together into an aqueous solution, subsequently the water is removed by vacuum. The so obtained sheet like product is dried and is heated and finally pressed whereby the thermoplastic material softens and keeps the fibres together upon cooling. A description of this process can be found in US 4,734,321.

In another process for making suitable substrates reinforcing fibres and fibres of a thermoplastic material are admixed and the obtained structure is needled. The needled structure is heated and finally pressed to an intermediate product. This process is described for instance in WO 02/076711.

The content of reinforcing fibres in the substrate can vary within a broad range. The content of reinforcing fibres varies usually between 20 to 90 % by weight.

The fibres have an average length of about 7 to 200 millimetres.

The substrates have a low density and are air permeable. The substrate usually has a thickness of between 1 to 10 millimetres.

THE COVER LAYER

The cover layer or cover layers is/are formed by a long or continuous fibre reinforced thermoplastic film or prepreg with the long or continuous fibres being orientated approximately parallel to another. Such films are commercially available.

The films can be made for example drawing a plurality of continuous filaments through a melt of a thermoplastic polymer with a relatively low melt viscosity while keeping the filaments aligned along the direction of the draw under

tension. Such a process has been described for instance in EP A- 0 056 703. The average length of the long fibres is over 100 millimetres. The fibres are individually embedded in the thermoplastic material. The thickness of the film varies between about 0.1 and 1.0 millimetres.

THE REINFORCING FIBERS

The material of the reinforcing fibres in the substrate and in the cover layer can be the same or can be different. The fibres can be made out of glass (all types of glass are suitable), carbon, synthetic materials, mineral or natural materials.

THE THERMOPLASTIC MATERIAL

The thermoplastic material of the substrate and of the cover layer can be the same or can be different. They should however be selected so that the substrate and the cover layer bond together upon heating them under pressure and at elevated temperatures. Suitable thermoplastic materials are for example polyolefins, polycarbonates, vinyl aromatic homopolymers, vinyl aromatic compounds containing copolymers, vinyl aromatic compounds containing graft copolymers or vinyl aromatic compounds containing block copolymers, thermoplastic polyesters, thermoplastic polyurethanes, polyetherimides; polyphenylene sulfide, polyphenylene ethers, polyamides or blends of thermoplastic materials comprising at least one of the mentioned thermoplastic materials.

PROCESS FOR MAKING THE MULTILAYER PRODUCT

The manufacture of the multilayer product of the invention is relatively simple. On both sides of the substrate as defined in the claims are applied one or more layers of the film. To prevent distortions of the mulitlayer product of the invention it is simplest to apply on each side of the substrate the same number of films and with a balanced orientation. When using more than one layer of the film the film is usually applied such that the direction of the long or continuous fibres of each subsequent layer differs from the orientation of the previous layer. This is normally as a 0°/90° lay-up but may also be uni-directional or quasi isotropic lay-up depending on the

application. The substrate and the film are heated together under pressure at a temperature to assure good bonding between the substrate and the film or prepreg layer. During this process or in a subsequent step the multilayer product may be moulded into the desired three dimensionally shaped forms by pressing or vacuum consolidating it in a properly shaped mould. It is also possible to subject the substrate to a treatment under heat and pressure prior to applying the film cover layer.

PAINTING THE MULTILAYER PRODUCT

The multilayer product may be painted with one or more paint layers. To obtain an optimal surface quality and good adherence of the paint layers a pre-treatment of the surface of the multilayer product may be advisable. Such pre-treatment may consist for example of the application of suitable primer layer and or surface flame treatment.

USE OF PRODUCT INVENTION

The products of the invention can be used in many applications. Due to their low density, great stiffness, low CTE and good surface quality they are ideally suited for use as body panels for the automotive industry or outdoor vehicles.